

## **AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application:

### **Listing of Claims:**

Claim 1 (Previously Presented): A method of simulating movement of an autonomous entity through an environment, the method comprising:

providing a provisional path through a model of the environment from a current location to an intended destination;

providing a profile for said autonomous entity;

determining a preferred step towards said intended destination based upon said profile and said provisional path, wherein determining said preferred step comprises determining a first dissatisfaction function for expressing a cost of taking a step comprising a sum of an inconvenience function for expressing a cost of deviating from a given direction and a frustration function for expressing a cost of deviating from a given speed;

determining a personal space around said autonomous entity;

determining whether said preferred step is feasible by considering whether obstructions infringe said personal space; and

recording a feasible preferred step so as to allow movement of said autonomous

entity to be determined.

Claim 2 (Currently Amended): A method according to claim 1, wherein if said preferred step is not feasible, then the method further comprises:

determining a region in which to seek a compromise step; ~~and~~  
determining whether at least one compromise step is feasible;  
choosing one of a plurality of compromise steps; and  
recording said one of the plurality of compromise steps so as to allow movement  
of said autonomous entity to be determined.

Claim 3 (Canceled).

Claim 4 (Previously Presented): A method according to claim 2, wherein determining said region includes adapting step parameters for determining said region in dependence upon at least one locally perceivable condition.

Claim 5 (Previously Presented): A method according to claim 2, wherein determining said region includes adapting step parameters for determining said region in dependence upon memory of past conditions.

Claim 6 (Previously Presented): A method according to claim 1, wherein the determining of said personal space comprises defining a region in which absence of

obstructions is sought.

Claim 7 (Previously Presented): A method according to claim 1, wherein said obstructions include other autonomous entities.

Claim 8 (Previously Presented): A method according to claim 1, wherein said obstructions include fixed obstructions.

Claim 9 (Previously Presented): A method according to claim 1, further comprising determining said inconvenience function for expressing a cost of deviating from a given direction.

Claim 10 (Previously Presented): A method according to claim 9, wherein said provisional path includes a direction from said current location to said intended destination and said profile includes a preferred step length, and wherein the determining of said inconvenience function includes:

determining a first amount of work required to take a step of given step length;  
determining a second amount of work which is a proportion of said first amount of work corresponding to a component which is not directed in said optimal direction.

Claim 11 (Previously Presented): A method according to claim 10, wherein the determining of said inconvenience function includes:

determining an acceleration associated with a change in velocity between said step and a previous step and

determining a third amount of work required to produce said acceleration.

Claim 12 (Previously Presented): A method according to claim 11, wherein the determining of said inconvenience function includes summing said second and third amounts of work.

Claim 13 (Previously Presented): A method according to claim 1, further comprising determining said frustration function.

Claim 14 (Previously Presented): A method according to claim 13, wherein said profile includes a preferred walking speed and the determining of said frustration function comprises:

determining a preferred instantaneous walking speed by adding said preferred walking speed to walking speed noise;

determining an amount of work dependent upon a walking speed and said preferred instantaneous walking speed.

Claim 15 (Previously Presented): A method according to claim 1, wherein the determining of said preferred step comprises:

minimising said first dissatisfaction function in respect of step length;

minimising said first dissatisfaction function in respect of step orientation;  
thereby to obtain a preferred step length and a preferred step orientation.

Claim 16 (Previously Presented): A method according to claim 1, wherein the determining of whether said preferred step is feasible comprises determining a discomfort function for expressing a cost arising from said autonomous entity having to keep a distance which is less than a preferred distance from an obstruction.

Claim 17 (Previously Presented): A method according to claim 1, further comprising  
providing a preferred clearance tolerance for said autonomous entity; and  
determining said personal space around said autonomous entity in dependence upon said preferred clearance tolerance.

Claim 18 (Previously Presented): A method according to claim 17, further comprising:  
determining a density of neighbouring entities and  
determining said personal space around said autonomous entity in dependence upon said preferred clearance tolerance and said density of neighbouring entities.

Claim 19 (Previously Presented): A method according to claim 17, further comprising:

providing information relating to velocity of said autonomous entity; and  
determining an angular dependency for said personal space in dependence upon  
said velocity.

Claim 20 (Previously Presented): A method according to claim 1, wherein said  
considering of whether obstructions infringe said personal space comprises:

determining whether said personal space is infringed at a first position along said  
preferred step and

determining whether said personal space is infringed at a second position along  
said preferred step.

Claim 21 (Previously Presented): A method according to claim 20, wherein said  
considering of whether obstructions infringe said personal space further comprises:

determining whether said personal space is infringed at a third position along said  
preferred step.

Claim 22 (Previously Presented): A method according to claim 1, wherein if said  
preferred step is not feasible, then the method further comprises:

determining a region in which to seek a compromise step.

Claim 23 (Original): A method according to claim 22, wherein the determining of  
said region comprises defining an arc.

Claim 24 (Previously Presented): A method according to claim 1, further comprising:

determining a set of attributes for said autonomous entity in dependence upon said profile.

Claim 25 (Previously Presented): A method according to claim 24, wherein the determining of said set of attributes comprises:

determining at least one attribute at a time of generating said autonomous entity.

Claim 26 (Original): A method according to claim 24, further comprising:

modifying at least one attribute of said set of attributes for said autonomous entity.

Claim 27 (Previously Presented): A method according to claim 1, wherein providing said profile for said autonomous entity comprises:

basing said profile on a set of measured attributes.

Claim 28 (Previously Presented): A method according to claim 1, wherein providing said profile for said autonomous entity comprises:

statistically assigning said profile.

Claim 29 (Previously Presented): A method according to claim 1, wherein

providing said profile for said autonomous entity comprises:

providing said profile in dependence upon at least one aspect of said environment.

Claim 30 (Previously Presented): A method according to claim 1, wherein providing said provisional path through said model of the environment from said current location to said intended destination comprises:

determining a bearing from said current location to said intended destination.

Claim 31 (Previously Presented): A method according to claim 1, further comprising:

providing a preferred clearance tolerance for said autonomous entity; and

determining said personal space around said autonomous entity in dependence upon said preferred clearance tolerance.

Claim 32 (Previously Presented): A method according to claim 31, comprising:  
determining a density of neighbouring entities and  
determining said personal space around said autonomous entity in dependence upon said preferred clearance tolerance and said density of neighbouring entities.

Claim 33 (Previously Presented): A method according to claim 31, comprising:  
providing information relating to velocity of said autonomous entity; and  
determining an angular dependency for said personal space in dependence upon



said velocity.

Claim 34 (Previously Presented): A method of designing a building structure, the method comprising:

providing a model of said building structure;

simulating movement of at least one autonomous entity through said building structure; and

revising said model of said building structure in dependence upon movement of said at least one autonomous entity, wherein the simulating of the movement comprises:

providing a provisional path through said model of the building structure from a current location to an intended destination;

providing a profile for said autonomous entity;

determining a preferred step towards said intended destination based upon said profile and said provisional path, wherein determining said preferred step comprises determining a first dissatisfaction function for expressing a cost of taking a step comprising a sum of an inconvenience function for expressing a cost of deviating from a given direction and a frustration function for expressing a cost of deviating from a given speed;

determining a personal space around said autonomous entity;

determining whether said preferred step is feasible by considering whether obstructions infringe said personal space; and

recording a feasible preferred step so as to allow movement of said autonomous entity to be determined.

Claim 35 (Previously Presented): A method according to claim 1, further comprising:

determining said preferred step towards said intended destination while minimising deviation from a preferred speed.

Claim 36 (Previously Presented): A method according to claim 1, further comprising:

determining said preferred step towards said intended destination while maintaining at least a minimum distance from obstacles.

Claim 37 (Previously Presented): A method according to claim 1, further comprising:

defining a neighbourhood;  
scanning said neighbourhood for obstacles;  
determining at least one condition relating to said obstacles and  
defining an area in which to seek a step towards said destination in dependence upon said at least one condition.

Claim 38 (Currently Amended): A method of simulating movement of an

autonomous entity through an environment from a current location to an intended destination, the method comprising:

providing a provisional path through a model of the environment from a current location to an intended destination;

providing a profile for said autonomous entity;

determining a preferred step towards said intended destination based upon said profile and said provisional path;

determining a personal space around said autonomous entity;

determining whether said preferred step is feasible by considering whether obstructions infringe said personal space;

recording a feasible preferred step so as to allow movement of said autonomous entity to be determined; and

if said preferred step is not feasible, determining a compromise step and recording the compromise step so as to allow movement of said autonomous entity to be determined, wherein determining a compromise step includes:

defining a neighbourhood;

scanning said neighbourhood for obstacles;

determining at least one condition relating to said obstacles and

defining an area in which to seek a step towards said destination in dependence upon said at least one condition.

Claim 39 (Previously Presented): A method according to claim 37, wherein determining said at least one condition relating to said obstacles comprises:

determining a density of one type of obstacle.

Claim 40 (Previously Presented): A method according to claim 37, wherein defining said area in which to seek a step towards said destination comprises:

establishing an angular range for a search.

Claim 41 (Previously Presented): A method according to claim 37, wherein defining said area in which to seek a step towards said destination comprises:

determining to which side of a preferred direction to search.

Claim 42 (Previously Presented): A computer program tangibly embodied on a computer-readable medium, the computer program comprising computer executable instructions for a method of simulating movement of an autonomous entity through an environment, the method comprising:

providing a provisional path through a model of the environment from a current location to an intended destination;

providing a profile for said autonomous entity;

determining a preferred step towards said intended destination based upon said profile and said provisional path, wherein determining said preferred step comprises determining a first dissatisfaction function for expressing a cost of taking a step

comprising a sum of an inconvenience function for expressing a cost of deviating from a given direction and a frustration function for expressing a cost of deviating from a given speed;

determining a personal space around said autonomous entity;

determining whether said preferred step is feasible by considering whether obstructions infringe said personal space; and

recording a feasible preferred step so as to allow movement of said autonomous entity to be determined.

Claim 43 (Previously Presented): A computer-readable medium storing a computer program comprising computer executable instructions for a method of simulating movement of an autonomous entity through an environment, the method comprising:

providing a provisional path through a model of the environment from a current location to an intended destination;

providing a profile for said autonomous entity;

determining a preferred step towards said intended destination based upon said profile and said provisional path, wherein determining said preferred step comprises determining a first dissatisfaction function for expressing a cost of taking a step comprising a sum of an inconvenience function for expressing a cost of deviating from a given direction and a frustration function for expressing a cost of deviating from a given speed;

determining a personal space around said autonomous entity;  
determining whether said preferred step is feasible by considering whether obstructions infringe said personal space; and  
recording a feasible preferred step so as to allow movement of said autonomous entity to be determined.

Claim 44 (Previously Presented): Apparatus configured to perform a method of simulating movement of an autonomous entity through an environment, the method comprising:

providing a provisional path through a model of the environment from a current location to an intended destination;

providing a profile for said autonomous entity;

determining a preferred step towards said intended destination based upon said profile and said provisional path, wherein determining said preferred step comprises determining a first dissatisfaction function for expressing a cost of taking a step comprising a sum of an inconvenience function for expressing a cost of deviating from a given direction and a frustration function for expressing a cost of deviating from a given speed;

determining a personal space around said autonomous entity;

determining whether said preferred step is feasible by considering whether obstructions infringe said personal space; and

recording a feasible preferred step so as to allow movement of said autonomous

entity to be determined.

Claim 45 (Original): Apparatus for simulating movement of an autonomous entity through an environment, the apparatus comprising:

means for providing a provisional path through a model of the environment from a current location to an intended destination;

means for providing a profile for said autonomous entity;

means for determining a preferred step towards said intended destination based upon said profile and said provisional path; said determining means configured to determine a first dissatisfaction function for expressing a cost of taking a step comprising a sum of an inconvenience function for expressing a cost of deviating from a given direction and a frustration function for expressing a cost of deviating from a given speed;

means for determining a personal space around said autonomous entity;

means for determining whether said preferred step is feasible by considering whether obstructions infringe said personal space.

Claim 46 (Previously Presented): Apparatus for simulating movement of an autonomous entity through an environment, the apparatus comprising:

means for providing a provisional path through a model of the environment from a current location to an intended destination;

means for providing a profile for said autonomous entity;

means for determining a preferred step towards said intended destination based upon said profile and said provisional path;

means for determining a personal space around said autonomous entity;

means for determining whether said preferred step is feasible by considering whether obstructions infringe said personal space and, if said preferred step is not feasible, for determining a compromise step,

wherein said means for determining a compromise step includes:

means for defining a neighbourhood;

means for scanning said neighbourhood for obstacles;

means for determining at least one condition relating to said obstacles; and

means for defining an area in which to seek a step towards said destination in dependence upon said at least one condition.

Claim 47 (Previously Presented): Apparatus for simulating movement of an autonomous entity through an environment, the apparatus comprising:

an interface for providing a provisional path through a model of the environment from a current location to an intended destination and for providing a profile for said autonomous entity;

a processor for determining a preferred step towards said intended destination based upon said profile and said provisional path, wherein said processor is configured to determine a first dissatisfaction function for expressing a cost of taking a step



comprising a sum of an inconvenience function for expressing a cost of deviating from a given direction and a frustration function for expressing a cost of deviating from a given speed;

said processor determining a personal space around said autonomous entity; and

said processor determining whether said preferred step is feasible by considering whether obstructions infringe said personal space.

Claim 48 (Previously Presented): Apparatus for simulating movement of an autonomous entity through an environment, the apparatus comprising:

an interface for providing a provisional path through a model of the environment from a current location to an intended destination and for providing a profile for said autonomous entity;

a processor for determining a preferred step towards said intended destination based upon said profile and said provisional path, for determining a personal space around said autonomous entity, and for determining whether said preferred step is feasible by considering whether obstructions infringe said personal space and, if said preferred step is not feasible, for determining a compromise step,

wherein said processor is configured define a neighbourhood, scan said neighbourhood for obstacles, determine at least one condition relating to said obstacles; and define an area in which to seek a step towards said destination in dependence upon said at least one condition.